# MODIS Team Meeting Minutes

## Minutes of the MODIS Team Meeting held on Tuesday August 22, 1995.

## Action Items:

113. Determine the best method to display a fixed pattern noise (herringbone, Spec 3.4.5.3.3). Assigned to Knight 8/15/95. Due 10/15/95.

114. Determine the extent of ghosting from the SMIR polished cold shield. Assigned to Waluschka 8/29/95. Due 9/22/95.

## Distribution:

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|---|---|---|
| ✓ Richard Weber | ✓ Bruce Guenther | Larissa Graziani |
| ✓ John Bauernschub | George Daelemans | ✓ Bob Martineau |
| Rosemary Vail | Mitch Davis | ✓ Bob Silva |
| Lisa Shears | Ken Anderson | ✓ Robert Kiwak |
| ✓ Mike Roberto | ✓ Rick Sabatino | ✓ Harvey Safren |
| ✓ Gene Waluschka | Cherie Congedo | ✓ Ed Knight |
| ✓ Bill Barnes | ✓ Jose Florez | Harry Montgomery |
| ✓ Les Thompson | ✓ Gerry Godden | ✓ Marvin Maxwell |
| ✓ John Bolton | ✓ Sal Cicchelli | Bill Mocarsky |

The following items were distributed:

1) Weekly Status Report #203
2) SBRC Memos submission from week #195
3) Minutes of the previous team meeting

## MODIS Technical Weekly September 1, 1995

sent to MODIS.Review 9/5/95 at about 8:30 AM

### 1.0 Introduction

The Calibration Peer Review will be at SBRC on September 13 and 14. Splinter sessions are planned for September 15.

Kirsten Parker and Ed Knight have prepared a document titled SRCA Operations and Concepts Document, dated August 23, 1995. This document describes the MODIS Characterization Support Team (MCST) flight operations plans for the SRCA. It describes on-orbit tests and the operations data base.

Eugene Waluschka has written a memo dated August 16 titled Response to the MODIS Scatter Measurement (ScMA) Evaluation Action Item. The ScMA 12 inch mirror has a surface roughness of about 3.75 Angstroms. The report concludes that the mirror's surface scatter is not a limiting factor in the ScMA's ability to characterize the MODIS near field response.

In a memo dated August 28, 1995, Larry Goldberg has written about Icing Effects in the MODIS EM Cooled Optics Ports. Larry has concluded that there is little doubt that ice existed in the cold optical paths during the EM TV tests. He states that the MODIS EM calibration of the cooled detector bands is not valid.

Marvin Maxwell has written preliminary comments on the Linearity of MODIS IR Channels in the EM TV Tests in a memo dated August 18. The memo presents a preliminary assessment of the curvature in the radiance versus digital number output of the MODIS Engineering model during run #452 with charge subtraction On and Off. His preliminary conclusions are as follows: "In general the data was very linear, the drift of the DN of space was low and the data had low noise and/or scatter and was smooth. Many channels exhibited early saturation or odd behavior. In general this behavior could be attributed to a very high background flux, marginal detectors or occasional data processing errors (or perhaps MODIS multiplexer errors). The most confusing behavior was that some of the channels showed a curvature which was inverted from the expected tendency of the DN vs Radiance data to have a reduced slope as the input radiance increased."

Ed Knight provided a Flight Operations Workshop Report, preliminary comments (including comments from Tim Zukowski) on the PFM Test Compliance Matrix, and questions and concerns regarding the 8/31/95 LMAS meeting.

Lee Tessmer has the responses from Jim Young regarding Gerry Godden's August 15 email on IR Calibration Traceability.

Gerry Godden provides initial brief comments on the secondary mirror specification. He also comments on the results of the results of the Hughes El Segundo ORDAS straylight analysis of the solar diffuser, door, screen, bulkhead and diffuser which indicate that there will be 1% straylight contamination during SD measurements. The question is what should we do regarding this calibration. Gerry offers a few possible suggestions.

## 2.0 Ed Knight ( Flight Operations Workshop Report, PFM Test Compliance Matrix, Questions and Concerns regarding 8/31/95 LMAS Meeting)

email from Ed Knight 8/28/95 5:21 PM
Flight Operations Workshop Report
To: MODSOT Distribution August 28, 1995
From: Ed Knight

Report on August 23-24, 1995 Flight Operations Workshop

For two days we met with representatives from 421, FOS, FOT, Lockheed-Martin, and the other Instrument Teams. Topics of discussion included Project level I&T, the Mission Readiness Review and Schedule, Ground System Requirements, Planning Aids, Spacecraft Maneuvers, Planning and Scheduling Timelines, Spacecraft Safe and Survival Modes, the OICDs, Memory Loads, IST network connectivity, a preview of the FOS CDR, and the Prototype Results Review. In addition, Claire Wilda, Bruce Guenther, John Mehrten and I held a short meeting to discuss expected deliverables and plans for the next year. In addition, 6 formal action items and 8 informal action items were generated. These are attached at the end of this email.

Some specific notes of interest are as follows:

The ECS FOS CDR will be held October 17-19, 1995.

There will be another AM-1 Operations Workshop in February. Ed Chang would appreciate feedback on the agenda.

There will be a Mission Operations Review in Summer 1996. Requirements for passing this review have not yet been set.

From discussions with Carol Lloyd, I understand the IOT's to be responsible for populating the following database tables: PDB Definitions (telemetry, command, constraint, activity), Operational Activity Database (definitions, Baseline Activity Profile, detailed schedule).

Multiple Operations home pages are up now.

Master Command and Telemetry list is due Jan/Feb 1996. This is a SBRC responsibility, but Bruce would like MODSOT to track the progress of the MODIS database for meeting these requirements.

Need to follow up with SBRC on their presence during A&E, specifically wrt facility requirements. We will also want to review "critical" telemetry.

The "Operations Day" is 30 hours long to allow a 6 hours buffer. We need to define what commands should be executed in the last few minutes of the day to keep the instrument safe if no more commands are received.

The FOS has appointed an instrument advocate and point of contact. Rick Broome serves us for MODIS.

The following are the Formal Action Items from the Workshop:

1. Instrument Operations Teams to Identify preliminary Facility Requirements (Due Sept. 14, response to be drafted by K. Parker).

2. Instrument Operations Teams to generate justifications for desired Ground System Requirements which have been deemed "out of scope." (Due Sept. 21, response to be drafted by E. Knight).

3. Instrument Operations Teams to fill in the columns of Jeff Kronenwetter's planning aids matrix. (Due Sept.14, response to be drafted by E. Knight).

4. Instrument Operations Teams to evaluate Mike Rackley's proposed requirements for IST connectivity performance (Due Sept. 7)

Preliminary Response: The latency and jitter requirements defined are within the capabilities of the GSFC LAN, by our understanding. We have no problems with these requirements.

(if anyone has any concerns about this, please let me know--Ed).

5. Instrument Operations Teams to provide CRC algorithms (due Sept. 15, E. Knight to draft response).

6. Instrument Operations Teams to react to proposed processor load approach (due in 3-4 weeks, E. Knight to draft response.

In addition, Kirsten and I believe that we have 8 informal actions to follow up on. These are:

7. Andy Miller distributed a handout on the current planned reports that will be generated by the FOS. He has requested feedback on the completeness of the list. (list is FOS_RPT.XLS). (Knight)

8. We should track down details from the MOM schedule maintained by Angie Kelly. We also need to talk to Janice Smith about instrument participation in the I&T plans. These will become requirements on us in many cases. (Parker)

9. We should get a copy of the Mission Operations Readiness handbook. (Parker)

10. We have enough preliminary information to identify items we may need to order for the ISTs. We need to pull together a list of these. (Parker)

11. Several questions arose on software to access the DAAC. We need to gather appropriate information. (Parker)

12. Jim Creegan requested feedback on our planned IST platform. (Parker).

13. Claire distributed a Quasi-MODIS ICD. We need to provide comments. (Parker, Knight)

14. Jim Creegan asked for review of the preliminary IST screen designs. (Parker)

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PFM Test Compliance Matrix
email from Ed Knight 8/25/95 at 3:03 PM

Mike,

I asked Tim to look at Tom Pagano's test compliance matrix. While I hope to do so myself, I thought I would forward his comments to you immediately. His comments are in > and mine initial responses are in plain text.

Ed

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>3.3.3 Spectral Bands. Are you concerned that these measurements
>generally, filter shifts are predictable with temp., but I don't know
>if you have this kind of component data, or whether this is an issue or not.

Shifts with temperature should be small over the range of particular instrument temperatures but we may way wish to doublecheck with Sam Pellicori.

>3.4.4, Transient Response. Note that this is only the test using the
>ScMA, done in the high bay. On EM, of course, this was also tested
>using the IAC in the MCC under vacuum, because of the lack of IR
>band response. I think we should not omit verifying to some extent
>the High Bay measurements for PFM by the same means. This
>might reveal electronics subtleties otherwise missed, because the
>instrument operating condition would be different.

SBRC should be prepared for a need to issue a similar STR if the thermal focal planes do not get good NFR data again.

>3.4.9, In-flight Calibrators. Similar remark as 3.3.3; apparently they
>will only be calibrated at the instrument nominal temperature - this
>probably is inadequate for the spectral calibration, at least,
>because the SRCA filters and reference diodes will be affected by
>temp variations. I'm not sure if there would be any real effect on
>the radiometric calibration, unless there is significant instrument
>background contribution. This may be only a minor issue, however,
>if operational scenarios lead to always operating the SRCA at one
>particular instrument temp. (that does not seem possible to me IMHO).

Tim's comment here is appropriate. It is not adequate to only check the SRCA radiometric mode at a single instrument temperature. If we launch and end up in a different temperature, we risk losing traceability to orbit (a spec. requirement). It should be possible to piggy back a 1W SRCA limited radiometric test onto the standard radiometric calibration tests.

>3.4.9.4, Why is ecal never operated in T/V? This is relatively
>trivial, and should be done at all inst. temps.

Again, this should be done.

>General: Again, they have omitted any specifics regarding operating
>at all focal plane temperature set points. This must include doing
>calibrations at all set points, not just verifying that the FPAs can
>be operated at each temp. After all, they must produce a radiometric
>CALIBRATION, which can be used as the basis of the on-orbit
>radiometry; if no calibration is done at different set-points, then 3
>yrs. into the mission, when you are obliged to change set points, you
>lose your traceability to the ground standards, and probably must accept a greater uncertainty.

This is a point we have raised before and need to continue raising.

>Well there you go,

>Tim

Ed

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email from Ed, 8/30/95 at 3:58 PM
Questions and Concerns regarding 8/31 LMAS Meeting

Marv and Mike, August 30, 1995

I've gone through the viewgraph packet from LMAS for tomorrow's presentation and have the following questions/concerns that I would appreciate you tracking for me.

nkb-23 Refers to 5 minute internal calibrations. What is this time

and how was it determined? (SRCA calibrations are typically longer).

nkb-25 MODSOT/MCST should help identify activities that would be run in simulated orbits. When is this information needed?

nkb-26 The definition of "mode" is going to cause some problems, since we use "Science Mode" to cover all of our calibration activities as well. For "calibration mode", "quiet mode", and "noisy mode", what range of calibration activities are we expected to test?

nkb-27 The definition of special tests is instrument specific tests that have been deferred to spacecraft level testing. If instrument level testing is shortened due to schedule problems, how much time is available for "make up" type special tests at the spacecraft level? When do these special tests become finalized?

nkb-31 It is our understanding that the Bench Acceptance Test is wholly an SBRC responsibility.

nkb-34 Does this interface verification test include checks of all Redundant connections?

nkb-39 (see nkb-27). Our "standard" operation will be with the OBC BB at ambient. Is heating the BB an "alternate mode?" Similar activities (summarized in the Operations Concept Document) can be commanded for all on-board calibrators and will be run albeit infrequently. Do we need to test every planned activity?

nkb-45 How is an Operations Simulation going to be complete or realistic if data is transferred via tape?

Thanks,

Ed

### 3. Lee Tessmer (Comments on Dr. Godden's IR Calibration Traceability Email Message)

email from Lee 9/1/95 at 2:32 PM

I attach Jim Young's comment as an enclosure as well as a paste in to the text below (in order to defeat the garbling problem we see from time to time.

The paste-in (note that the bold face gets washed out by the paste into E-mail format):

Responses to various parts of G. Godden E mail message are given below. The "bold" statements are from Gerry's comments. This area is of concern since the required IR calibration accuracy is "state-of-the-art". It may be appropriate to have some view graphs that would address this at a splinter meeting after the CPR.

(editor's note: Gerry's comment is at the beginning of each item and is in bold italic and ends with a colon. This is followed by Jim Young's response. Gerry's statements are excerpts from his email message "IR Calibration Traceability" on August 15 at 5:31 PM)

***1. MODIS calibration is to be traceable to NIST spectral radiance or irradiance standards:***

I know of no IR standards that can be used to calibrate BCS. NIST does have a low background infrared facility (LBIR). However, its size cannot handle BCS. NIST indicated this was going to be upgraded. I don't know when.

Although it is not a standard I understand from Jim Butler, NASA/GSFC, that NIST is being funded to develop a cryogenic radiometer. Presumably this would be usable for measuring BCS and OBC BB. This cryogenic radiometer will be usable in ambient and in vacuum.

### *2. There are no known plans for calibration of BCS traceable to NIST:*

This is true so far as spectral radiance is concerned. The BCS temperature sensors calibration is "traceable" to NIST.

### *3. Possible alternate route is secondary calibration re emissivity, temperature, wavelength, etc:*

I know of no NIST emissivity and/or wavelength standards that are applicable. As noted above, NIST temperature standards will be used.

### *4. Atmospheric transmission effects are significant for certain bands:*

Atmospheric transmission effects are treated in PL3095-N05082 IM entitled "Atmospheric Transmittance Effects on Calibration" from J. B. Young, dated 28 June 1995.

### *5. Presumably temperature is traceable to NIST*

Yes.

### *6. It is unknown how emissivity is being handled by SBRC, EOS, or MCST:*

As previously reported, the BCS emittance is obtained by measuring the BRDF of the BCS polished flat internal surfaces and then the effective cavity emittance is computed using an OARDAS model. Furthermore, since the three cavity surfaces have different temperature uncertainties, this is factored into the BCS spectral radiance model.

### *7. BCS had cracked anodized surfaces which were then painted:*

The BCS surfaces did sustain some crazing. However, no paint was used on the BCS surfaces. The OBC BB anodized surfaces also crazed and CTL 15 paint was used on these surfaces.

BRDF characterization of the crazed BCS surfaces were made. This data was inserted in an OARDAS model. The calculated emittance prior to crazing was > 0.9998 and 0.9993 after crazing. Our BCS emittance specification was >= 0.999.

### *8. BCS temperature range needs to be restricted:*

The BCS temperature range was restricted to less than 350 K. This posed no problem; see PL3095-N04291 IM entitled, "Blackbody Calibration Source (BCS) Radiometric Model Analysis" from J. B. Young, dated 29 Sept 1995.

### *9. No known plan to measure the BCS emissivity in a manner traceable to NIST:*

This is true. As indicated above, I know of no available NIST emissivity standards. However, as indicated above, NIST has been funded to develop cryogenic radiometer which perhaps could be used.

### *10. Careful attention needs to be paid to this area:*

We agree that careful attention needs to be paid to this whole area. I believe we are trying to achieve some performance levels that are currently beyond the state of the art (my opinion). Of course, this is one of the reasons why emphasis has been placed on the use of multiple calibration methodologies.

### *11. Need an error analysis although this may be of limited usefulness due to "temperature stability, charge subtraction uncertainties, path length corrections, etc and several modeling assumptions:*

As you may have noted, I am not a proponent of "complete" error analyses -- principally because I never feel I have enough data / knowledge to do a realistic one. And as a result, I feel as if I am pulling numbers out of the air which I "dislike with a passion". To the extent that variables can be modeled, the sensitivity of the calibration on the variable can be ascertained and this can be very useful, but only as a partial solution.

### *12. Consider measuring/comparing OBC BB with NIST sources:*

For this to be realistic the scan cavity and OBC BB would need to be compared to NIST sources. I doubt that this is realistic. On the other hand, the aforementioned NIST cryogenic radiometer may be a good transfer radiometer. This should be explored.

Note that OBC BB surface reflectance / emittance was measured at SBRC, see PL3095-Q04474 IM entitled "Emissivity measurement of MODIS OBC blackbody" from Robert Turtle dated 7 Dec 1994. with the results from the EM system test. This will probably not be definitive but it will provide a couple of data points.

Regards,

Lee

### 4. Gerry Godden (Secondary Mirror Specification, Solar Diffuser Stray Light)

Secondary Mirror Specification
email from Gerry Godden, 8/30/95 at 11:37 AM

I just received the Secondary Mirror specification that Tom Kampe FAXed to you. I have several comments on this specification, similar to the ones I put in my 8/23/95 email message regarding Tom's IM PL3095-Q05258. I do not have the time to comment in depth right now. Briefly:

1) The scratch/dig specification is an antiquated spec and at 40-20. I believe that a scratch/dig of 20/40 is way too large. Consider Paul Spyak's treatise paper on particulate scatter, wherein, he concludes that a single 10 micron diameter particle/cm2 will have a major impact on the BRDF.

2) I do not understand, nor agree with, specifying TIS. The modern way of specifying optical scatter is with a BRDF measurement. Presumably the TIS will be calculated based on BRDF measurements encompassing a few percent of the clear aperture.

3) It is unclear whether or not these specifications apply to the polished substrate prior to coating, or to the coated mirror. The difference is important. We need a BRDF of the order of (0.03,-2.0;measured at 0.57 degrees from specular), or better, for the coated mirror.

3) No one can measure TIS from 0.2 degrees outward at 3.39 and 10.6 microns.

4) If this spec were to be used for the Fold Mirror, the increase chamfer would be a likely disaster. Presumably the field stop precludes chamfer scatter from the edges of the Secondary Mirror.

Gerry Godden

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Solar Diffuser Stray Light
email from Gerry Godden 8/28/95 at 11:15 AM

Bruce just picked up a SBRC comment that the Hughes El Segundo ORDAS straylight analysis of the solar diffuser, door, screen, bulkhead and diffuser indicates that there will be 1% straylight contamination during SD measurements (1.00=B10.01 suns on the SD as a function of theta and phi, orbital position, season, etc.).

There is no mention regarding what SBRC plans to do about this. Since it might be argued that 1% is within the allowed radiometric uncertainty for the reflective bands, it could well turn out that nothing will be done about this. It is not known what the major sources of the straylight are. Dick Weber directed SBRC to drill and tap the beryllium bulkhead for required screw holes so the option could be keep open to add a knife edge aperture plate to the bulkhead SD port. It seems unlikely that SBRC will measure the straylight effect on the PFM (though arguably they should to confirm a null straylight response).

The question is raised, "What should we do about this regarding calibration"? If we do not get satisfactory characterization of the SD straylight during SBRC testing of the PFM, then it seems we will have to rely on analysis and on-orbit measurement. The risk of relying on the ORDAS analysis is that the model may be too simplified (features such as glints, edge scatter, etc. are quite difficult to accurately model), and whereas the ORDAS model may indicate the straylight to be a slowly varying function of theta and phi, in reality there could be glints or scatter paths that show up only at a very narrow angular range. This would argue for tests to measure the straylight carefully, in small angular increments through out the 7=B0 to 9=B0 declination by 23=B0 azimuth angular range for = which the SD will be used (a difficult goniometric test).

An option to consider (if we do not get hardware fixes and detailed straylight measurements) is to use the ORDAS model results (hopefully available in suitable format) to develop a nominal straylight correction algorithm to carry in to orbit, and then follow-up with on-orbit measurement of the SD straylight function (difficult to do because we will be guessing for quite a while, what part of any change is due to straylight changes and what part is due to SD or instrument calibration changes). Notionally, we could map out the SD straylight in 1=B0 increments through ou= t the 7=B0 by 23=B0 operational angular range (161 measurements, probably time= s two or three to get some measure of the overall stability, and to help isolate other SD and instrument degradation factors. This would call for commanding a small and precise spacecraft maneuver, once per orbit for 23 to 35 days (161/14 =3D 11.5 days X 2 to 3). A considerable round the clock effort during A&E.

We need to be very attentive to the actual details of what is going on here and start thinking ahead about how we are going to accomplish the measurements we need to reduce our total uncertainty to within the allowed budgets.

Gerry Godden

MR
9/5/95